RESEARCH ON MULTI-TIME SCALE MODELING OF ELECTRO-THERMAL COUPLING IES

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Multi-energy complementary and coordinative operation can effectively improve the comprehensive utilization of energy, which can not only promote the consumption of renewable energy, but also effectively reduce energy costs and improve the reliability of energy use. The electric-thermal coupling multi-energy system is an important form of multi-energy complementary coordination, which is prevalent and continues to develop in the northern region of China. Therefore, the study of multi-time-scale modeling of electrothermal coupled energy network is of great significance to improve the anti-jamming ability of the whole system and strengthen the interaction between systems.

Keywords: multi-time scale.

1. Structure analysis and model of electro-thermal coupling system

A. System structure. The power system, coupling element, and heating system make up the three main structural components of an electro-thermal coupling multi-energy flow system, as depicted in Fig. 1.

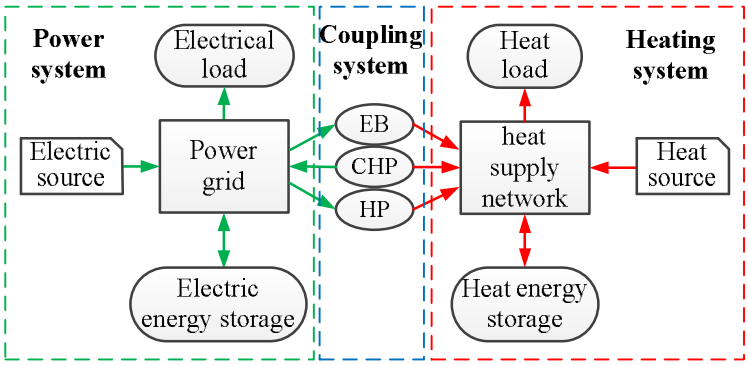

Fig. 1. Structure diagram of electro-thermal coupling multi-energy flow system

The electro-thermal coupling multi-energy flow system, which serves as the foundation for the electro-thermal synergy, is made up primarily of the coupling element in the coupling system, as can be seen from Fig. 1. China's power system is moving in the direction of developing a new power system with renewable energy as its main component and promoting the development of green and low-carbon energy [1].

B. Heating System Model. Heat load, heat network, and heat source make up the majority of the heating system. Through the heat network, the heat source transfers heat to the heat load, and the heat network distributes that heat according to the flow of the medium.

C. Electro-thermal Coupling System Model. Electrothermal coupling components mainly include CHP, electric boiler, solar heat pump and circulating pump of heat network system.

D. Multi-time Scale Comprehensive Model. In the electro-thermal system, there is multi-energy coupling and interaction, but the process of its leading effect varies depending on the time period. As a result, the electro-thermal coupled multi-energy flow system's multi-time scale characteristics can be described in stages.

2. Case study

In normal operation, the power supply fluctuation of the power supply system is taken as the disturbance to analyze the impact on the heating system. The G1 synchronous generator set is replaced with a wind-wind complementary power generation system, in which wind power generation 2.5 MW and photovoltaic power generation 2.5 MW are shown in Fig. 2.

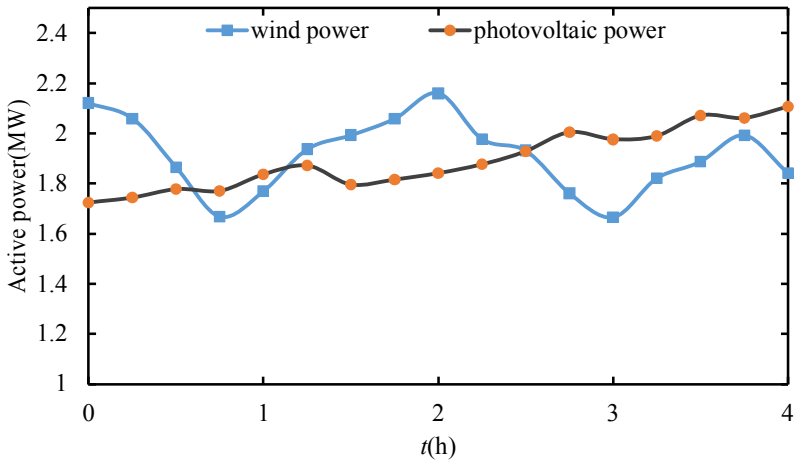

Fig. 2. The active power of wind farm and photovoltaic plant

Fig. 2 shows that while photovoltaic output data fluctuates steadily, wind power output fluctuates significantly. The electric load is maintained constant throughout the subsequent calculation process, which adopts a 5 minute calculation step.The parameters of the heating system and the power system have changed, as shown in Fig. 3 and 4, respectively.

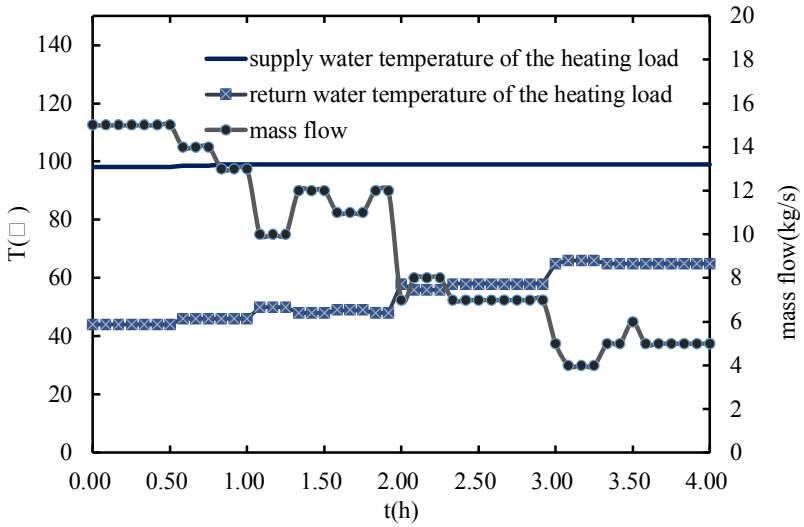

Fig. 3. Changes of heating system parameters

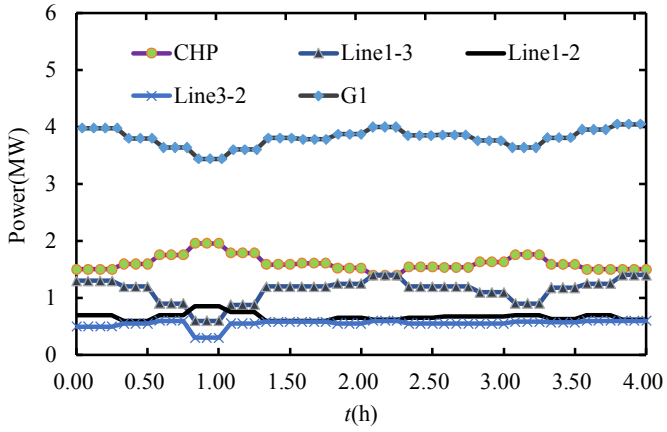

Fig. 4. Power distribution of power system

As can be seen from Fig. 3 and 4, the power balance of the power system is realized and the operation reliability of the power system is improved.

This paper examines the coupling modeling of an electrothermally coupled multi-energy flow system in accordance with the system's multi-time-scale properties. In order to increase the applicability of the model calculation and take into account the thermal dynamic process of the heating network of the heating system, a multi-time-scale dynamic model of the heating system is established. Calculations using a mathematical example show that electrothermal coupling can improve the system's anti-interference capability up to a point.

References

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NUMERICAL SIMULATION AND EXPERIMENTAL INVESTIGATION OF METHANE-AIR NON-PREMIXED STRONGLY SWIRLING COMBUSTION IN A NOVEL ASYMMETRIC SEMI-CONFINED COMBUSTOR

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In this paper, a novel asymmetric non-premixed combustor with well-defined geometric boundary is provided to enhance air/fuel mixing and improve flame stability. A comprehensive numerical model, which coupled with large-eddy simulation using a modified Sub-grid scales kinetic energy model and second-order moment combustion model using a simplified four steps chemical reaction mechanism, for non-premixed combustion in a semi-confined space is established. The results show that four isolated vortices characterized by the features of strongly rotating and tangential shear stress are formed in the corner region of combustor. With the increases of inlet gas velocity, the flame blow off do not happen and the average temperature in the combustor remain mostly uniform low and well distributed. Combustion intensity, vortex structures